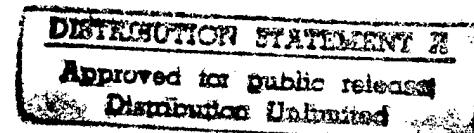


# Limited Energy Study of Hangar Facilities at Simmons Army Airfield (SAAF), Fort Bragg, North Carolina

## *Executive Summary*



CONTRACT #DACA01-94-D-0034  
DELIVERY ORDER 0004  
SYSTEMS CORP PROJECT #94013.04

April 26, 1995

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Savannah District-  
US Army Corps  
of Engineers

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SYSTEMS ENGINEERING AND MANAGEMENT CORPORATION



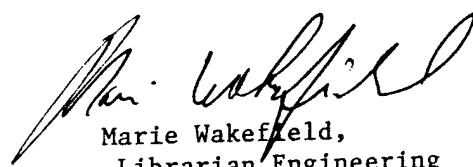
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ited Energy Study of Hangar Facilities  
on Army Airfield  
at Bragg, North Carolina

First Year Savings (\$1000) \$ 509

Energy Savings (MBTU/YR) 36,830

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## 1 EXECUTIVE SUMMARY

### *LIMITED ENERGY STUDY OF HANGAR FACILITIES AT SIMMONS ARMY AIRFIELD, FT. BRAGG, NC*

This document has been prepared to provide a final report on the project. It also provides information required to identify projects for programming and preparation of necessary funding documentation. The projects are formed by grouping energy conservation opportunities (ECOs) for the buildings into packages which meet specific funding criteria.

## **1 EXECUTIVE SUMMARY**

*LIMITED ENERGY STUDY OF HANGAR FACILITIES AT SIMMONS ARMY AIRFIELD, FT. BRAGG, NC*

### **1.1 SUMMARY RESULTS**

This analysis involved 14 hangar buildings located at Simmons Army Airfield at Fort Bragg. The buildings range in age from 1950s construction to late 1980s construction. All are currently heated by oil-fired boilers serving unit heaters in high bay areas, and radiators or fan-coils in other areas. Few have centralized cooling systems; most utilize window units for cooling. Most hangars currently utilize mercury vapor or incandescent lighting.

Four specific energy conservation opportunities (ECOs) were analyzed for this report:

- ECO-1: Install High Efficiency Interior/Exterior Lighting Systems
- ECO-2: Install Natural Gas Boilers and Infrared Heaters
- ECO-3: Install Electric Infrared Heaters
- ECO-4: Renovate HVAC Systems

ECO-1 incorporates changing from T-12 fluorescent to T-8 fluorescent fixtures; replacing incandescents with compact fluorescents; replacing mercury vapors with metal halide or high pressure sodium; retrofitting incandescent exit sign lamps with LED lamps and installing skylights with automatic lighting controls in high bay areas.

The analyses for ECO-1 were performed on a building-by-building basis, and all but two (2) buildings resulted in a payback of less than 10 years and an SIR of greater than 1.25. Buildings 2936 and 3007 had an SIR of less than 1.25. These two buildings were then analyzed as high bay and non-high bay areas in an attempt to create individual lighting opportunities. This resulted in a payback for only the sky lighting portion of these buildings. All feasible lighting opportunities were then grouped together for one project. The total project for ECO-1 has an investment cost of \$680,783 with a payback of 4.05 years and an SIR of 2.12.

ECO-2 evaluates replacing oil-fired boilers with natural gas boilers and unit heaters in high bay areas with natural gas infrared heaters. The installation requires a four-mile extension of a natural gas main to the airfield. The ECO was analyzed in two ways:

1. In ECO-2A, North Carolina Natural Gas (NCNG) funds the gas line extension.
2. In ECO-2B, Fort Bragg pays for the gas line construction.

The only difference in the two is the up-front investment cost to the Government, and in either case the project qualifies for funding. However, since it is unlikely (at this time) that NCNG will provide funds for the project, ECO-2B is the one recommended for funding.

## 1 EXECUTIVE SUMMARY

### *LIMITED ENERGY STUDY OF HANGAR FACILITIES AT SIMMONS ARMY AIRFIELD, FT. BRAGG, NC*

ECO-3 is the installation of electric infrared heaters in high bay areas. For this installation, the existing electrical source to each building must be upgraded to accommodate the additional electrical load. In energy simulations, the sum of new electrical demand and energy charges is greater than the current cost of fuel oil heating. Thus, the ECO has a negative payback and savings-to-investment ratio (SIR) and cannot be recommended for further analysis.

ECO-4 is the renovation of existing HVAC systems to install more efficient systems. Where central systems already exist, they were replaced with more efficient variable air volume (VAV) systems. Where no central system exists, new VAV systems were simulated. None of the renovations qualified for funding, due to the relatively small areas within each building which require both heating and cooling, resulting in little attainable energy savings.

#### **1.2 RECOMMENDED PROJECTS AND ORGANIZATION**

A considerable amount of data has been generated as a result of this study to date. There is a wide variety of ways to present the data. Systems Corp has presented the data in five tables to provide the installation with different viewpoints. The first table (*Table 1.1.1*) simply lists all of the ECOs in order from highest to lowest savings-to-investment ratio (SIR), in accordance with the Scope of Work. In addition, we have presented four other listings which should give the installation a clearer choice of project groupings.

The second listing is *Table 1.1.2*. We have listed only those ECOs recommended for consideration. Projects can only be recommended if the SIR is greater than 1.25 and the simple payback is ten years or less.

The third listing is *Table 1.1.3*. We have listed only those ECOs not recommended for implementation. If the simple payback is greater than ten years or the SIR is less than 1.25, the ECO is not recommended.

The fourth listing is *Table 1.1.4*. This table lists the recommended ECOs by building. This presentation indicates the work required in each building if all ECOs are implemented. The listing also totals the investment costs and the first year savings. We have purposely provided only relevant information in these tables, omitting other data which is available in many locations throughout this report.

The fifth listing is *Table 1.1.5*, which presents the total SIR and simple payback if all ECOs evaluated are implemented. A grand total SIR and simple payback was computed totaling all buildings and ECOs.

## 1 EXECUTIVE SUMMARY

### *LIMITED ENERGY STUDY OF HANGAR FACILITIES AT SIMMONS ARMY AIRFIELD, FT. BRAGG, NC*

ECOs 2A and 2B are mutually exclusive. At this time, negotiations with NCNG to fund the gas line extension are not promising, so ECO 2B is the option recommended for funding. At the request of Fort Bragg personnel who will continue to negotiate with NCNG, *Tables 1.1.2 and 1.1.4* show ECO 2A as an alternative .

ECO-3 and 4 are clearly not recommended due to the extremely long paybacks and low SIRs.

The logical grouping for projects is to combine all the recommended lighting projects (ECO-1) into one project and the natural gas improvements (ECO-2B) into another project grouping. The necessary information for funding documentation of these projects is found in Appendix C.

# 1 EXECUTIVE SUMMARY

LIMITED ENERGY STUDY OF HANGAR FACILITIES AT SIMMONS ARMY AIRFIELD, FT. BRAGG, NC

TABLE 1.1.1

ALL ECOs FROM HIGHEST TO LOWEST SIR

ECO NUMBER	BUILDING NUMBER	TOTAL INVESTMENT	1st YEAR SAVINGS	SIMPLE PAYBACK	SIR	AIRR
2A	8944	\$190,425	\$46,633	4.08	4.39	10.91%
2A	4242	\$48,326	\$12,100	3.99	4.34	10.85%
2A	4137	\$62,506	\$14,655	4.27	4.22	10.69%
2A	3354	\$79,087	\$18,457	4.29	4.15	10.59%
2A	3262	\$145,961	\$31,726	4.60	3.95	10.32%
2A	7937	\$192,072	\$40,966	4.69	3.90	10.26%
2A	3962	\$89,267	\$19,664	4.54	3.88	10.23%
2B	8944	\$224,672	\$46,633	4.82	3.72	10.00%
1	3962	\$52,595	\$22,028	2.39	3.60	17.19%
2A	3954	\$79,087	\$15,358	5.15	3.45	9.58%
1	3637	\$41,771	\$16,545	2.52	3.43	16.62%
2B	7937	\$226,319	\$40,966	5.52	3.31	9.36%
2A	3642	\$89,267	\$15,654	5.70	3.21	9.19%
2B	3262	\$180,208	\$31,726	5.68	3.20	9.17%
1	3642	\$66,699	\$24,039	2.77	3.10	15.43%
2A	9647	\$170,718	\$28,526	5.98	3.07	8.93%
2A	3637	\$82,716	\$13,375	6.18	2.96	8.74%
2A	3007	\$171,792	\$27,540	6.24	2.96	8.74%
2A	3807	\$171,766	\$27,484	6.25	2.95	8.73%
2B	3354	\$113,336	\$18,457	6.14	2.89	8.62%
2B	3962	\$123,514	\$19,664	6.28	2.81	8.45%
2A	2936	\$186,838	\$28,937	6.46	2.80	8.45%
2B	4137	\$96,755	\$14,655	6.60	2.73	8.30%
2B	9647	\$204,967	\$28,526	7.19	2.55	7.94%
2B	4242	\$82,573	\$12,100	6.82	2.54	7.92%
1	4137	\$41,016	\$12,098	3.39	2.54	13.17%
2B	3007	\$206,039	\$27,540	7.48	2.47	7.76%
2B	3807	\$206,013	\$27,484	7.50	2.43	7.75%
1	3262	\$94,048	\$26,347	3.57	2.42	12.64%
2B	3954	\$113,336	\$15,358	7.38	2.41	7.62%
2B	2936	\$221,085	\$28,937	7.64	2.37	7.54%
2B	3642	\$123,514	\$15,654	7.89	2.32	7.43%
1	4242	\$21,694	\$5,340	4.06	2.11	11.09%
2B	3637	\$116,965	\$13,375	8.75	2.09	6.87%
1.1	2936 High Bay	\$27,647	\$5,626	4.91	1.75	9.06%
4	3962	\$104,879	\$10,295	10.19	1.71	5.80%
1	3354	\$42,429	\$8,043	5.28	1.63	8.26%

## 1 EXECUTIVE SUMMARY

### LIMITED ENERGY STUDY OF HANGAR FACILITIES AT SIMMONS ARMY AIRFIELD, FT. BRAGG, NC

TABLE 1.1.1

#### ALL ECOs FROM HIGHEST TO LOWEST SIR

ECO NUMBER	BUILDING NUMBER	TOTAL INVESTMENT	1st YEAR SAVINGS	SIMPLE PAYBACK	SIR	AIRR
1	7937	\$62,380	\$11,606	5.37	1.60	8.09%
3	4242	\$64,550	\$3,767	17.14	1.48	
1.1	3007 High Bay	\$29,473	\$5,031	5.86	1.47	7.12%
1	8944	\$51,337	\$8,695	5.90	1.46	7.07%
1	3954	\$32,165	\$4,877	6.59	1.30	5.87%
1	3807	\$58,764	\$8,823	6.66	1.29	5.80%
1	9647	\$58,764	\$8,823	6.66	1.29	5.80%
1	2936	\$104,436	\$14,844	7.04	1.22	5.19%
1	3007	\$58,091	\$7,526	7.72	1.11	4.21%
1.2	2636 Non-high Bay	\$76,789	\$9,218	8.33	1.03	3.41%
4	4242	\$16,232	\$845	19.21	0.91	
4	3262	\$254,620	\$12,435	20.48	0.89	2.42%
4	3354	\$104,879	\$6,297	16.66	0.85	
1.2	3007 Non-high Bay	\$28,618	\$2,495	11.47	0.75	0.18%
4	2936	\$123,005	\$5,982	20.56	0.73	
3	8944	\$211,132	(\$5,186)	-40.71	0.55	
4	4137	\$84,677	\$2,319	36.52	0.51	
4	3637	\$84,677	\$994	85.22	0.28	-3.41%
4	3642	\$104,879	\$1,930	54.34	0.23	
3	3637	\$100,729	(\$6,429)	-15.67	-0.34	
3	7937	\$217,710	(\$17,343)	-12.55	-0.35	
3	4137	\$100,729	(\$6,691)	-15.05	-0.42	
3	3954	\$116,142	(\$8,638)	-13.45	-0.57	
3	3354	\$116,142	(\$8,446)	-13.75	-0.59	
3	3007	\$236,236	(\$19,518)	-12.10	-0.65	
3	3807	\$236,236	(\$19,922)	-11.86	-0.68	
3	9647	\$236,236	(\$20,571)	-11.48	-0.74	
3	3962	\$158,431	(\$12,453)	-12.72	-0.75	
3	3642	\$158,431	(\$16,199)	-9.78	-1.07	
3	2936	\$245,426	(\$29,379)	-8.35	-1.21	
3	3262	\$181,143	(\$30,288)	-5.98	-1.73	

# 1 EXECUTIVE SUMMARY

## LIMITED ENERGY STUDY OF HANGAR FACILITIES AT SIMMONS ARMY AIRFIELD, FT. BRAGG, NC

TABLE 1.1.2

### RECOMMENDED ECOs FROM HIGHEST TO LOWEST SIR

ECO NUMBER	BUILDING NUMBER	TOTAL INVESTMENT	1st YEAR SAVINGS	SIMPLE PAYBACK	SIR	AIRR
2A	8944	\$190,425	\$46,633	4.08	4.39	10.91%
2A	4242	\$48,326	\$12,100	3.99	4.34	10.85%
2A	4137	\$62,505	\$14,655	4.27	4.22	10.69%
2A	3354	\$79,087	\$18,457	4.29	4.15	10.59%
2A	3262	\$145,961	\$31,726	4.60	3.95	10.32%
2A	7937	\$192,072	\$40,966	4.69	3.90	10.26%
2A	3962	\$89,267	\$19,664	4.54	3.88	10.23%
2B	8944	\$224,672	\$46,633	4.82	3.72	10.00%
1	3962	\$52,595	\$22,028	2.39	3.60	17.19%
2A	3954	\$79,087	\$15,358	5.15	3.45	9.58%
1	3637	\$41,771	\$16,545	2.52	3.43	16.62%
2B	7937	\$226,319	\$40,966	5.52	3.31	9.36%
2A	3642	\$89,267	\$15,654	5.70	3.21	9.19%
2B	3262	\$180,208	\$31,726	5.68	3.20	9.17%
1	3642	\$66,699	\$24,039	2.77	3.10	15.43%
2A	9647	\$170,718	\$28,526	5.98	3.07	8.93%
2A	3007	\$171,792	\$27,540	6.24	2.96	8.74%
2A	3637	\$82,716	\$13,375	6.18	2.96	8.74%
2A	3807	\$171,766	\$27,484	6.25	2.95	8.73%
2B	3354	\$113,336	\$18,457	6.14	2.89	8.62%
2B	3962	\$123,514	\$19,665	6.28	2.81	8.45%
2A	2936	\$186,838	\$28,937	6.46	2.80	8.45%
2B	4137	\$96,755	\$14,655	6.60	2.73	8.30%
2B	9647	\$204,967	\$28,526	7.19	2.55	7.94%
1	4137	\$41,016	\$12,098	3.39	2.54	13.17%
2B	4242	\$82,573	\$12,100	6.82	2.54	7.92%
2B	3007	\$206,039	\$27,540	7.48	2.47	7.76%
2B	3807	\$206,013	\$27,484	7.50	2.43	7.75%
1	3262	\$94,048	\$26,347	3.57	2.42	12.64%
2B	3954	\$113,336	\$15,358	7.38	2.41	7.62%
2B	2936	\$221,085	\$28,937	7.64	2.37	7.54%
2B	3642	\$123,514	\$15,654	7.89	2.32	7.43%
1	4242	\$21,694	\$5,340	4.06	2.11	11.09%
2B	3637	\$116,965	\$13,375	8.75	2.09	6.87%
1.1	2936 High Bay	\$27,647	\$5,626	4.94	1.75	9.06%
1.1	3007 High Bay	\$29,473	\$5,031	5.86	1.47	7.12%

# 1 EXECUTIVE SUMMARY

LIMITED ENERGY STUDY OF HANGAR FACILITIES AT SIMMONS ARMY AIRFIELD, FT. BRAGG, NC

TABLE 1.1.3

## NON-RECOMMENDED ECOs FROM HIGHEST TO LOWEST SIR

ECO NUMBER	BUILDING NUMBER	TOTAL INVESTMENT	1st YEAR SAVINGS	SIMPLE PAYBACK	SIR	AIRR
4	3962	\$104,879	\$10,295	10.19	1.71	5.80%
3	4242	\$64,550	\$3,767	17.14	1.48	
1.2	2936 High Bay	\$76,789	\$9,218	8.33	1.03	3.41%
4	4242	\$16,232	\$845	19.21	0.91	
4	3262	\$254,620	\$12,435	20.48	0.89	2.42%
4	3354	\$104,879	\$6,297	16.66	0.85	
1.2	3007 High Bay	\$28,618	\$2,495	11.47	0.75	0.18%
4	2936	\$123,005	\$5,982	20.56	0.73	
3	8944	\$211,132	(\$5,186)	-40.71	0.55	
4	4137	\$84,677	\$2,319	36.52	0.51	
4	3637	\$84,677	\$994	85.22	0.28	-3.41%
4	3642	\$104,879	\$1,930	54.34	0.23	
3	3637	\$100,729	(\$6,429)	-15.67	-0.34	
3	7937	\$217,710	(\$17,343)	-12.55	-0.35	
3	4137	\$100,729	(\$6,691)	-15.05	-0.42	
3	3954	\$116,142	(\$8,638)	-13.45	-0.57	
3	3354	\$116,142	(\$8,446)	-13.75	-0.59	
3	3007	\$236,236	(\$19,518)	-12.10	-0.65	
3	3807	\$236,236	(\$19,922)	-11.86	-0.68	
3	9647	\$236,236	(\$20,571)	-11.86	-0.74	
3	3962	\$158,431	(\$12,453)	-12.72	-0.75	
3	3642	\$158,431	(\$16,199)	-9.78	-1.07	
3	2936	\$245,426	(\$29,379)	-8.35	-1.21	
3	3262	\$181,143	(\$30,288)	-5.98	-1.73	

## 1 EXECUTIVE SUMMARY

### LIMITED ENERGY STUDY OF HANGAR FACILITIES AT SIMMONS ARMY AIRFIELD, FT. BRAGG, NC

TABLE 1.1.4

#### RECOMMENDED ECOs SORTED BY BUILDING NUMBER

ECO NUMBER	BUILDING NUMBER	TOTAL INVESTMENT	1st YEAR SAVINGS	SIMPLE PAYBACK	SIR	AIRR
1.1	2936 High Bay	\$27,647	\$5,626	4.91	1.75	9.06%
2A	2936	\$186,838	\$28,937	6.46	2.80	8.45%
2B	2936	\$221,085	\$28,937	7.64	2.37	7.54%
1.1	3007 High Bay	\$29,473	\$5,031	5.86	1.47	7.12%
2A	3007	\$171,792	\$27,540	6.24	2.96	8.74%
2B	3007	\$206,039	\$27,540	7.48	2.47	7.76%
2B	3262	\$180,208	\$31,726	5.68	3.20	9.17%
2A	3262	\$145,961	\$31,726	4.60	3.95	10.32%
1	3262	\$94,048	\$26,347	3.57	2.42	12.64%
1	3354	\$42,429	\$8,043	5.28	1.63	8.26%
2A	3354	\$79,087	\$18,457	4.29	4.15	10.59%
2B	3354	\$113,336	\$18,457	6.14	2.89	8.62%
2A	3637	\$82,716	\$13,375	6.18	2.96	8.74%
1	3637	\$41,771	\$16,545	2.52	3.43	16.62%
2B	3637	\$116,965	\$13,375	8.75	2.09	6.87%
2B	3642	\$123,514	\$15,654	7.89	2.32	7.43%
1	3642	\$66,699	\$24,039	2.77	3.10	15.43%
2A	3642	\$89,267	\$15,654	5.70	3.21	9.19%
2B	3807	\$206,013	\$27,484	7.50	2.43	7.75%
1	3807	\$58,764	\$8,823	6.66	1.29	5.80%
2A	3807	\$171,766	\$27,484	6.25	2.95	8.73%
2B	3954	\$113,336	\$15,358	7.38	2.41	7.62%
2A	3954	\$79,087	\$15,358	5.15	3.45	9.58%
1	3954	\$32,165	\$4,877	6.59	1.30	5.87%
2B	3962	\$123,514	\$19,664	6.28	2.81	8.45%
1	3962	\$52,595	\$22,028	2.39	3.60	17.19%
2A	3962	\$89,267	\$19,664	4.54	3.88	10.23%
2B	4137	\$96,755	\$14,655	6.60	2.73	8.30%
1	4137	\$41,016	\$12,098	3.39	2.54	13.17%
2A	4137	\$62,506	\$14,655	4.27	4.22	10.69%
1	4242	\$21,694	\$5,340	4.06	2.11	11.09%
2B	4242	\$82,573	\$12,100	6.82	2.54	7.92%

## 1 EXECUTIVE SUMMARY

LIMITED ENERGY STUDY OF HANGAR FACILITIES AT SIMMONS ARMY AIRFIELD, FT. BRAGG, NC

TABLE 1.1.4

### RECOMMENDED ECOs SORTED BY BUILDING NUMBER

ECO NUMBER	BUILDING NUMBER	TOTAL INVESTMENT	1st YEAR SAVINGS	SIMPLE PAYBACK	SIR	AIRR
2A	4242	\$48,326	\$12,100	3.99	4.34	10.85%
2A	7937	\$192,072	\$40,966	4.69	3.90	10.26%
1	7937	\$62,380	\$11,606	5.37	1.60	8.09%
2B	7937	\$226,319	\$40,966	5.52	3.31	9.36%
1	8944	\$51,337	\$8,695	5.90	1.46	7.07%
2A	8944	\$190,425	\$46,633	4.08	4.39	10.91%
2B	8944	\$224,672	\$46,633	4.82	3.72	10.00%
2B	9647	\$204,967	\$28,526	7.19	2.55	7.94%
1	9647	\$58,764	\$8,823	6.66	1.39	5.80%
2A	9647	\$170,718	\$28,526	5.98	3.07	8.93%

TABLE 1.1.5

### PROJECT RESULTS BY ECO

ECO NUMBER	TOTAL INVESTMENT	1st YEAR SAVINGS	SIMPLE PAYBACK	SIR	AIRR
ECO - 1	\$680,783	\$167,921	4.05	2.12	11.17%
ECO - 2A	\$1,759,820	\$341,074	5.16	3.51	9.67%
ECO - 2B	\$3,026,833	\$341,074	8.87	2.04	6.74%
ECO - 3	\$2,380,274	(\$197,291)	-12.06	-0.61	N/A
ECO - 4	\$877,848	\$41,095	21.36	0.88	N/A